A Functional Landscape Approach to managing wetland social-ecological systems

Experiences from the Kankhulukulu project in Malawi

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WetlandAction
for sustainable livelihoods and resource systems

University of Worcester

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Key points

- Across sub-Saharan Africa there is increasing dependency on wetland ecosystem services among poorer and vulnerable people in rural areas.
- The sustainable use of wetlands requires a social-ecological catchment wide management approach that balances livelihood needs with environmental sustainability.
- Wetland Action's Functional Landscape Approach (FLA) seeks to build adaptive co-management arrangements in communities to enhance ecosystem services, people's livelihoods, and climate change resilience.
- Between 2015 and 2018 the FLA was implemented in Kankhulukulu catchment, northern Malawi, as an action research project with the participation of 20+ households.
- The community self-organised to develop soil and water conservation measures, innovative wetland and upland farming practices, knowledge exchange initiatives, improved finance and marketing, and community-based institutions.
- Participants experienced significant gains in livelihood security that were underpinned by environmental enhancements and a more reslient social-ecological system.

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WetlandAction

Tiyeni

Wetlands and the Functional Landscape Approach in Malawi

Wetlands play a critical role throughout sub-Saharan Africa in providing a range of ecosystem services that support and sustain people's livelihoods – both through their direct contribution of provisioning services such as agriculture, water and livestock fodder, and through the regulating and supporting services that underpin these (MA 2005; Wood et al. 2013; Dixon 2018). In recent years, however, socio-economic, demographic and environmental change has driven agricultural intensification in wetlands, and consequently there has been renewed interest in addressing the problem of how wetlands can be used and managed in a manner that sustains (and enhances) ecosystem services and livelihood security. This challenge of sustainability, meanwhile, does not lend itself to narrow disciplinary-based management solutions (Berkes et al. 2003), and hence there is justification for adopting a more integrated social-ecological landscape approach. Wetland Action's 'Functional Landscape Approach' (FLA), which has been developed over two decades of action research among wetland communities, is an important innovation for wetland management and a potential means of addressing this existential challenge of increased use of wetlands across Sub-Saharan Africa.

The FLA essentially draws upon a holistic, social-ecological systems view of the dynamic relationship between people and the environment, in both space and time. It applies this to the specific context of wetlands and their catchments, and recognises how different landscape units in both the uplands and valley bottoms are linked through environmental and social processes, and how specific interventions and management strategies can support and sustain these inter-related ecosystem services and livelihoods (Wood and Thawe 2013). It draws upon a range of ideas from various disciplines including integrated catchment management (Lenton and Muller 2009), social-ecological systems (Berkes and Folke 1998; Berkes et al. 2003) ecological networks and mosaics (Mimet et al. 2013) ecoagriculture (Scherr and McNeely 2007), conservation agriculture (Knowler and Bradshaw 2007) and to some extent landscape character assessment techniques which seek to identify landscape units based on cultural and environmental features (Simensen et al. 2018). Indeed, the FLA can be seen as one of many integrated landscape approaches which have emerged in recent years as a means of conceptualising and reconciling the tensions between conservation and development at multiple scales and with multiple stakeholders (de Groot et al. 2010; Sayer et al. 2013; Milder et al. 2014; Freeman et al. 2015; Reed et al. 2020).

This situation is exemplified in the case of dambos, seasonal wetlands found throughout southern Africa, where degradation in the form of soil erosion and gullying has been attributed to destructive upland catchment land use activities such as deforestation and intensive agricultural production (Roberts 1988; McFarlane and Whitlow 1990; McCartney 2000). A FLA would involve recognising these linkages and subsequently proposing a range of physical measures to mitigate and adapt to the negative impacts; these could include afforestation initiatives, the designation of natural vegetation buffer zones around dambos, contour terracing, and composting, all of which are key components of an integrated, holistic system of wetland management (Wood and Thawe 2013). Critically, however, the FLA also acknowledges the importance of engaging local people and community-based social structures in facilitating these measures, and drawing upon the conceptual roots outlined above, seeks to build capacity for local institutional arrangements to co-ordinate land use

activities across the catchment and dambo, both as a means of controlling potentially damaging practices but also in promoting environmentally, socially and economically sustainable practices.

In summary, as well as being a lens for analysing the social-ecological inter-relationships in wetlands and their catchments, the FLA also seeks to build upon previous action research from different wetland social-ecological contexts to present a menu of practical environmental and socio-economic interventions for wetlands and catchments (Box 1). It also presents a framework and participatory process for these interventions (Figure 1). As a development approach, its goals include:

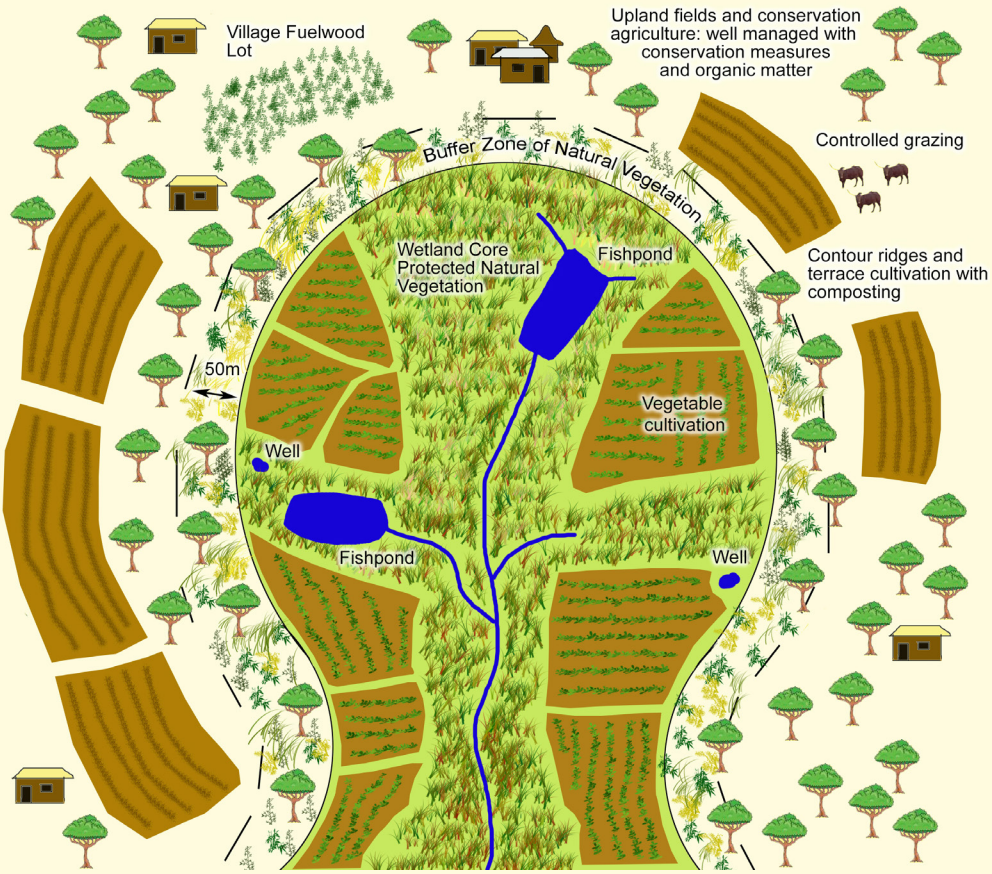
- **Maintenance and enhancement of the natural resource base** in a sustainable manner to support natural capital and ecosystem services;
- **Building improved, resilient and sustainable livelihoods** through increased income generation and food security through innovations in land management practices, especially managing water and nutrient flows, new crop opportunities and better marketing and processing of crops;
- **Strengthening community action** and building capacity to address livelihood and environmental challenges, through facilitating the creation of local institutions, clubs and social networks for knowledge exchange and self-reliance;
- **Facilitating the accumulation of assets** by farmers from their increased incomes, providing resilience against food insecurity and enabling income diversification through on-farm and off-farm activities to further spread risks.
- **Encouraging the development of local monitoring sytems** so communities can monitor and manage their resources through a process of adaptive co-management.

Using the FLA must involve discussions with the communities to explore their situation, identify problems they prioritise and also consider possible areas for action. Building on community-based needs assessment and analysis of the field situation through a participatory process, usually including transect walks, different communities and

Box 1 - The principles of the FLA.

FLA Technical measures

Measures implemented depend on the unique socio-ecological characteristics of each site, and are developed in collaboration with local resource users



In the Wetland

- **Wetland zoning** controls the expansion of cultivation and protects the centre of the wetland where natural vegetation helps stop erosion and gulley formation. Natural vegetation also enhances biodiversity.
- **Wells** in the centre of the wetland are avoided since they can become focal points for gulley formation.
- Ensuring the domestic water supply increases the value of wetlands.
- **Watering cans or treadle pumps** for water extraction need to be carefully monitored to ensure equitable access and avoid environmental degradation.
- **Wetland cultivation** should be restricted to small plots adapted to local conditions, and surrounded by natural vegetation buffer zones to reduce erosion.

In the Village

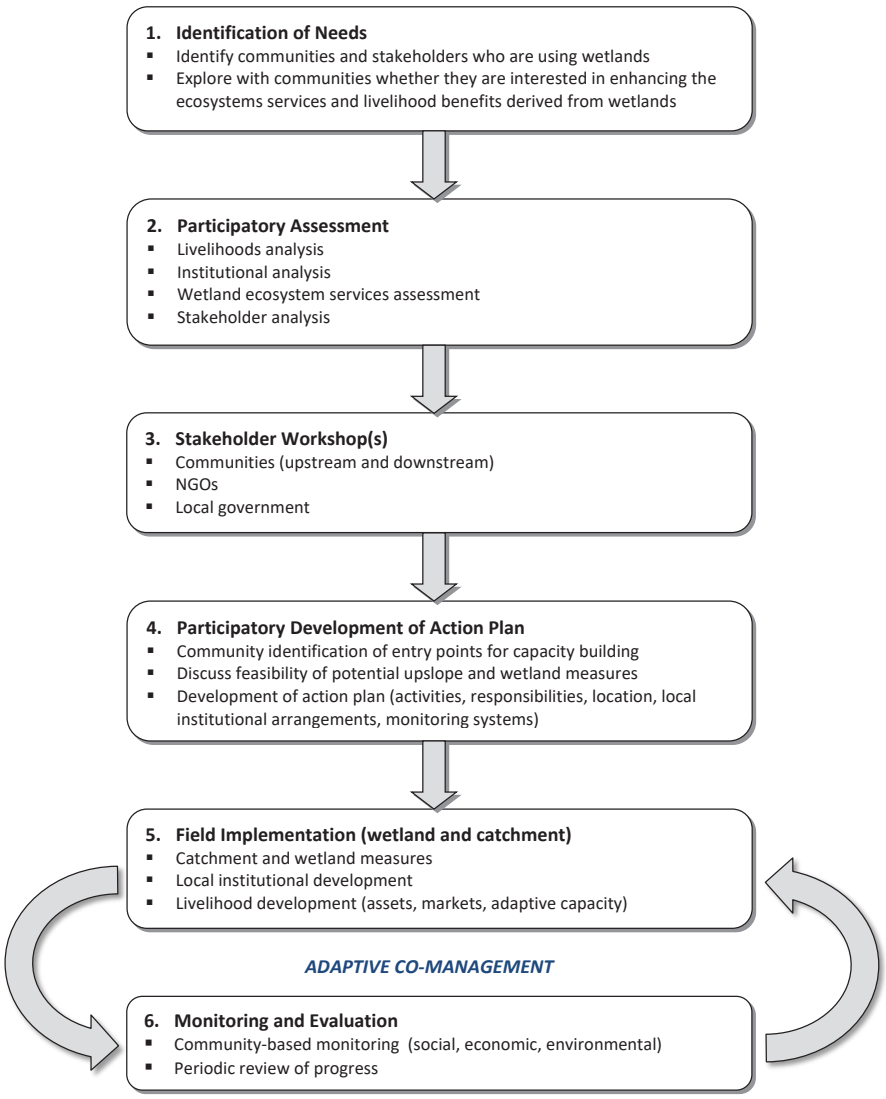
- **Village Natural Resource Management Committees** can be developed by communities to manage FLA interventions and resource use.
- **Village savings and loans** schemes can facilitate investment and improved marketing.

In the Catchment

- **Afforestation** improves rainfall infiltration which has positive effects on the wetland's water supply, and reduces runoff, erosion and sedimentation in wetlands.
- **Contour ridges** reduce runoff and encourage infiltration of rainfall.
- **Organic composting** improves crop yields and enhances water infiltration.
- **Conservation agriculture** techniques such as deep bed cultivation help improve water infiltration, soil structure and fertility.
- **Agroforestry** increases water infiltration, improves soil fertility and stability, and can provide marketable goods.
- **Wetland edge buffer zones** of natural vegetation prevent sediment and runoff reaching the wetlands.

Participatory action planning.

Figure 1 - A framework for FLA implementation



interest groups in the project area can be engaged in a workshop to review current understanding, drawing on local knowledge and external assessments. From this action planning can be developed, identifying specific measures for each different landscape unit to improve their functioning, productivity and sustainability. Implementing the FLA Action Plan requires community capacity development and organisation with institutional arrangements to support farmers, and groups of farmers, to coordinate their interventions and then to monitor and evaluate their impacts (Figure 1).

Researching the FLA

The FLA was specifically developed from over 20 years of research and implementation projects undertaken in several sub-Saharan Africa countries through partnerships between academics and NGOs under the co-ordination of Wetland Action. This began during the Ethiopian Wetlands Research Programme (EWRP) (1997 – 2000) and subsequent collaborative work with the Ethio-Wetlands and Natural Resources Association that drew attention to the important role played by local people and local natural resource management institutions in sustaining the benefits from wetlands in western Ethiopia (Dixon 2003; Dixon and Wood 2003). This later informed Wetland Action's work in the Wetlands International funded 'Striking a Balance' (SAB) project in Malawi and Zambia between 2005 and 2008, during which several communities worked in collaboration with local NGOs to analyse and enhance the management of their dambos and associated benefits (Wood and Thawe, 2013). Subsequently, the FLA has been adopted as a food security and resilience-building project intervention by a range of NGOs in the region, not least Self Help Africa who recently published a briefing paper outlining the important links between the FLA, livelihood development and resilience (Self Help Africa 2020).

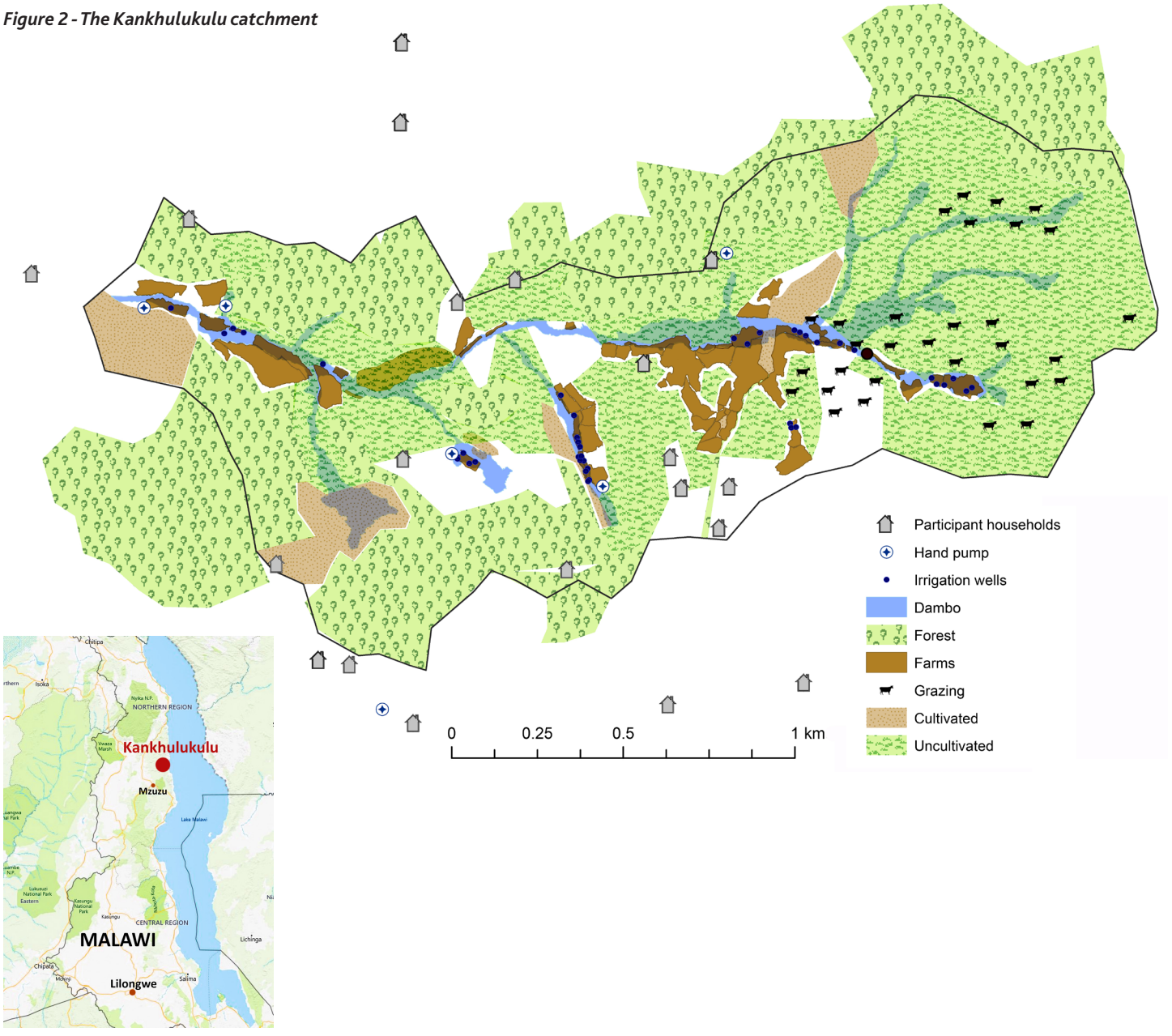
Despite growing evidence to suggest that the application of the FLA has produced significant win-win outcomes for both the environment and people's livelihoods in those areas where it has been implemented (see Wood and Thawe, 2013; Kotze et al. In Press), in 2014 researchers from the University of Worcester sought to address some questions raised regarding the long-term sustainability of FLA interventions. This was specifically in the context of Dixon and Carrie (2015) who evaluated the SAB project's local institutional developments in the context of Ostrom's work on effective common property resource institutions, but it also reflected a need to evaluate and understand in detail what elements of the FLA worked for whom and where, and ultimately ascertaining whether it could deliver on its promises of enhancing livelihoods *and* the environment through a process of building and integrating long-term adaptive capacity at the community level.

Hence in 2015 a three-year action research project commenced in the Kankhulukulu catchment (Figure 2) in northern Malawi to implement the FLA, but with a specific focus on evaluating and reflecting upon:

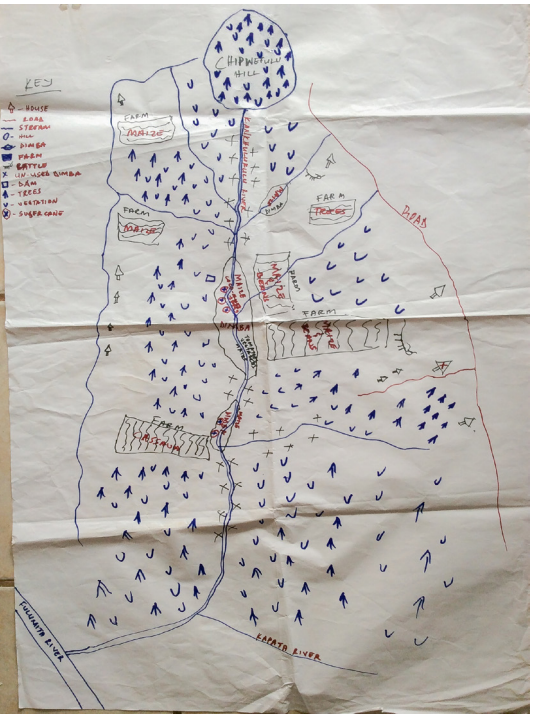
- the process of implementation - in order to establish lessons about the nature of community engagement, and the extent to which participatory and endogenous development can result in enhanced socio-economic and environmental outcomes, resilience and adaptive capacity;
- the impacts of the practical measures themselves. i.e. upland and wetland management practices and innovations.

In this paper we present an overview and reflect upon the experiences of implementing the FLA in Kankhulukulu between 2015 and 2017.

Figure 2 - The Kankhulukulu catchment



The Kankhulukulu catchment (foreground) looking west from Chipwefulo hill.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shortages from the upland harvest, although some dambo crops are sold for cash too. While Kankhulkulu is well endowed with dambo areas that remain wet all year round, only a small proportion of dambo was in cultivation at the beginning of the project; this was attributed to the lack of cash for inputs as well as a shortage of labour. Some farmers reported that their dambo land was suffering from degraded soils, and hence requested training on new techniques for sustainable dambo management.

Crop cultivation throughout the catchment is hindered by a range of problems including plant diseases, insect pests, crop raiding by wild animals (particularly baboons, pigs and birds), flooding and soil erosion, and the lack or marketing opportunities that act as a disincentive. Poor soil and water conservation and their associated low crop yields are the greatest cause of concern to farmers, who report significant changes in the quality of their soils over the years as indicated by colour, the presence of earthworms, changes in natural vegetation in particular areas (grasses, shrubs and trees) as well as their experiences of crop yields from one year to the next. Farmers reported that their soils were poorer in 2015 than the previous ten years, and that yields tended to decrease every year. The accumulating deposition of sand and debris in the Kankhulukulu stream is further noted as evidence of on-going soil erosion problems in the catchment, and according to farmers this has led to a reduction in water availability throughout the year in dambos.

The Kankhulukulu stream and adjacent dambo.

As part of a discussion of the components of the FLA and experiences of implementation elsewhere, farmers identified a range of potential solutions to their farming challenges:

- Wider adoption of the Tiyeni deep-bed farming (DBF) system. Farmers were aware of DBF from their relatives and via two group members practising it. DBF is perceived to have many benefits in terms of reducing erosion problems, improving soil fertility and water retention, reducing the reliance on NPK fertilisers due to its improved composting techniques, and ultimately its capacity to sometimes double the upland crop yield.
- Establishment of buffer zones around and between upland fields, between fields and dambos, and between dambos and the stream. This was presented as a means of reducing sedimentation and improving rainwater infiltration for the benefit of the Kankhulukulu stream and dambo farming.
- Encouraging greater use of organic fertilisers (manure) to reduce the costs of crop production and to improve soil quality. Farmers who discussed this referred to DBF manure-making techniques, and how the NGO Temwa had also trained them in manure-making for dambo vegetable cultivation in previous years.
- Encourage crop diversification as well as crop rotation. This was considered to have multiple benefits including building resilience to erratic rainfall patterns, improving sources of income, and improving soil quality, food security and nutrition.
- Low-tech environmental monitoring to complement their own local knowledge and provide a baseline for future change was originally proposed by the research team and farmers were keen to take this forward.
- Access to capital. Here farmers drew attention to economic challenges and how they lack the capital to invest in their agricultural activities and diversify their income. They suggested the formation of a village savings and loans scheme and financial training to address this situation.

Participatory needs assessment.

b. Unreliable markets and lack of control over prices

The group discussed the poor prices offered for their produce from vendors who were seen as exploiting farmers' dependence on them, and hence resulted in poor bargaining power. Establishing reliable markets was seen as key to improving their livelihoods. Suggestions for improving this included organising themselves and working as a co-operative in order to access more lucrative markets, as well as seeking training on marketing and business management (from other NGOs and farmers).

c. Lack of knowledge exchange amongst farmers

Farmers acknowledged that they each possessed unique knowledge of farming and their environment that they could share with each other. A specific cited example was the problem of rodent pests in cassava fields where one farmer had developed a technique using ants as a deterrent. In response, farmers agreed to commit more time to knowledge exchange via weekly group meetings and a dedicated 'knowledge sharing' committee.

Cattle grazing on Chipwefula hill.

d. Land and natural resources

Farmers reported no shortage of agricultural land in Kankhulukulu on account of the low population density. The catchment itself was only settled as recently as 1958 due to the expansion of coffee cultivation in the region, although there was an acknowledgement that migration to the area had increased in recent years due to land shortages in southern and central Malawi. The allocation of land within the catchment is dependent on obtaining permission from the village headman, and applicants must abide by a range of rules or risk being expelled from the community. Prohibited activities include witchcraft, charcoal production, and encouraging wildfires. Conversely, community members must be 'hardworking' and engage in tree planting (especially pine, Gmelina or Eucalyptus) to preserve the area and maintain timber supplies. If these rules are broken the offender is summoned to the village headman's court and fined (usually a goat or a chicken for a first offence).

Farmers see Chipwefula hill at the head of the catchment as the main source of water, but also an important grazing resource for cattle and as a source of thatching material, and hence agriculture is prohibited there. Water from the Kankhulukulu stream, which maintains flow all year round, is used for irrigation, washing, bathing and cooking. The stream also supports small fish that children catch for food. Drinking water is occasionally sourced from the stream (and boiled before use), but the main source of water are boreholes located around the catchment. During discussions farmers also emphasised the importance of the Katope tree (*Syzygium cordatum*), attributing its presence to water conservation; where Katope trees grow the surrounding area is waterlogged and these areas are protected.

e. Climate Change

This was a recurring theme in the initial discussion and throughout the duration of the project, with farmers reporting changes in observed rainfall patterns over many years. Since the mid-2000s rainfall has become erratic and unpredictable, and is regarded as affecting all the agricultural activities outlined above. Farmers attribute climate change to the loss of natural vegetation in the catchment and neighbouring areas, and hence this prompted them discuss and develop plans for protecting existing forests as well as planting new trees.

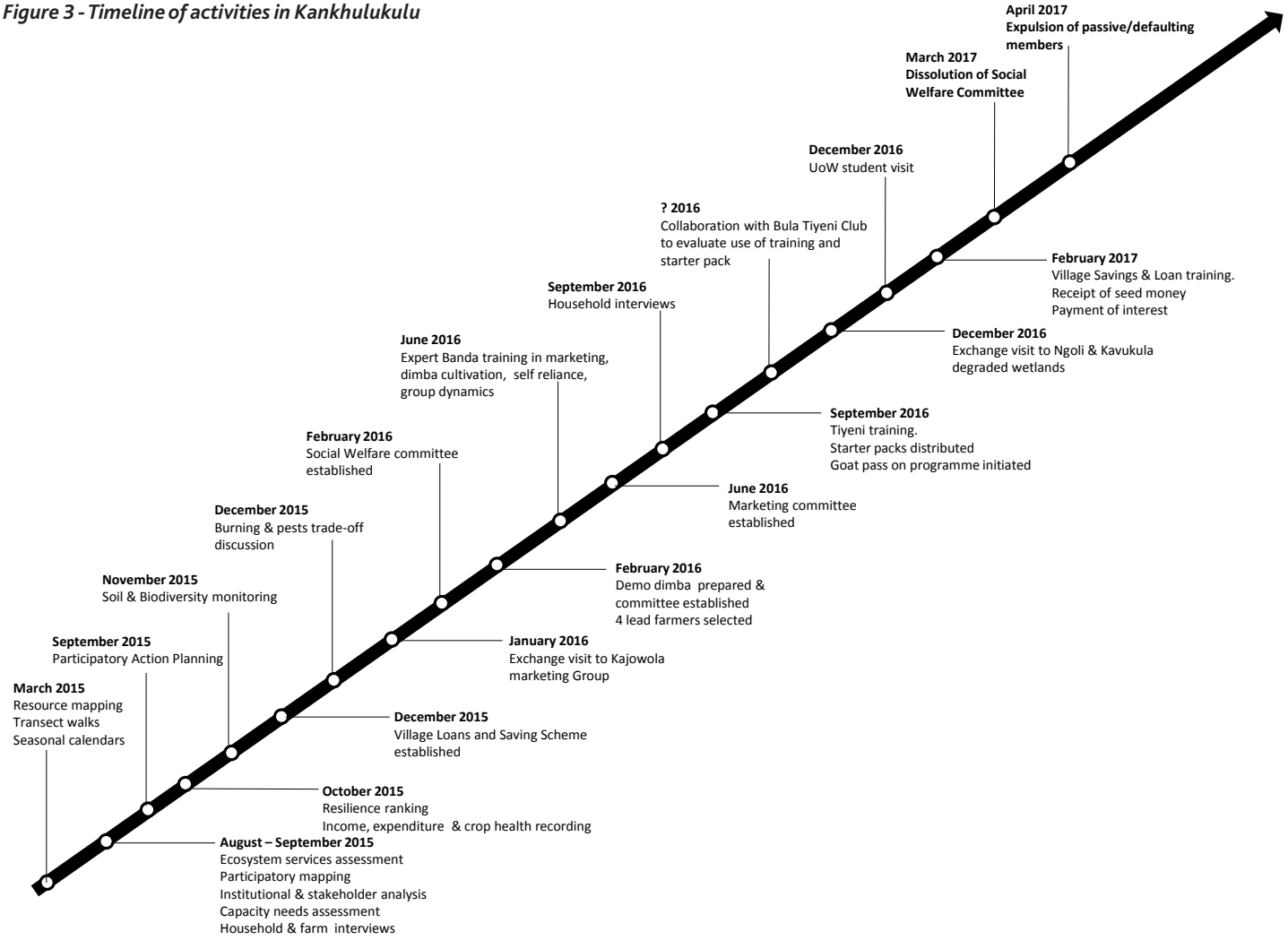
f. Burning

The burning of vegetation was also linked to the loss of natural land cover and disturbance of the rainfall cycle. Farmers lamented that they lose crops and important soil cover (crop residues) due to wildfires. While there was recognition that this has benefits in terms of releasing of nutrients to improve soil fertility, reducing pests and diseases, and preparing the fields for the rainy season, the negatives of crop loss, and the destruction of natural areas and soil cover were seen as outweighing the positives. In addressing the problem the group asked the village headman to take action and request a collective effort to reduce burning and to identify the perpetrators. It was revealed, however, that these fires mostly originated from people travelling through Kankhulukulu (e.g. those smoking tobacco).

Implementing the FLA

Following the preliminary discussions of concerns, challenges and potential solutions, the Kankhulukulu FLA group and the research team commenced further discussion and development of a plan of specific catchment and community development interventions. Again, the emphasis here was facilitating a process of community mobilisation that was essentially driven by the needs and aspirations of the FLA group, but also informed by the team's discussion of the various components of the FLA. This was seen as an important step towards developing community ownership over the project and hence taking the work beyond previous FLA implementation projects in which communities were participants rather than being leaders and planners. As such, all the activities between November 2015 and August 2017 highlighted in Figure 3 emerged from weekly group discussions. It is also worth noting here that prior to the project, farmers worked individually and rarely came together as a group; an issue they recognised as hindering their ability to acquire new ideas or to solve problems. As the project progressed, however, there was a growing recognition within the group that discussion and co-ordination was useful and educational, not least given the range of common challenges outlined above.

Figure 3 - Timeline of activities in Kankhulukulu



Nonetheless, despite the continuous efforts of the research team to clarify the nature of their involvement and the goals of the project, there were some changes in membership and participation in the FLA group and its activities most notably between March and August 2015 when membership increased from 11 to 30. Thereafter, this declined steadily to around 20 members for the final year of the project. Discussions revealed that initial growth in membership was due to an assumption (often based on past experience) that NGOs provided physical 'handouts' of cash, fertiliser or seed, and hence once it became clear that the FLA project was different, participation declined. So entrenched was this view that initially some farmers accused the field coordinator of deliberately blocking the distribution of assets, and keeping them for his own benefit.

Environmental, livelihood and ecosystem services assessment

Various environmental and livelihood assessment initiatives were undertaken over the duration of the project. These had three goals:

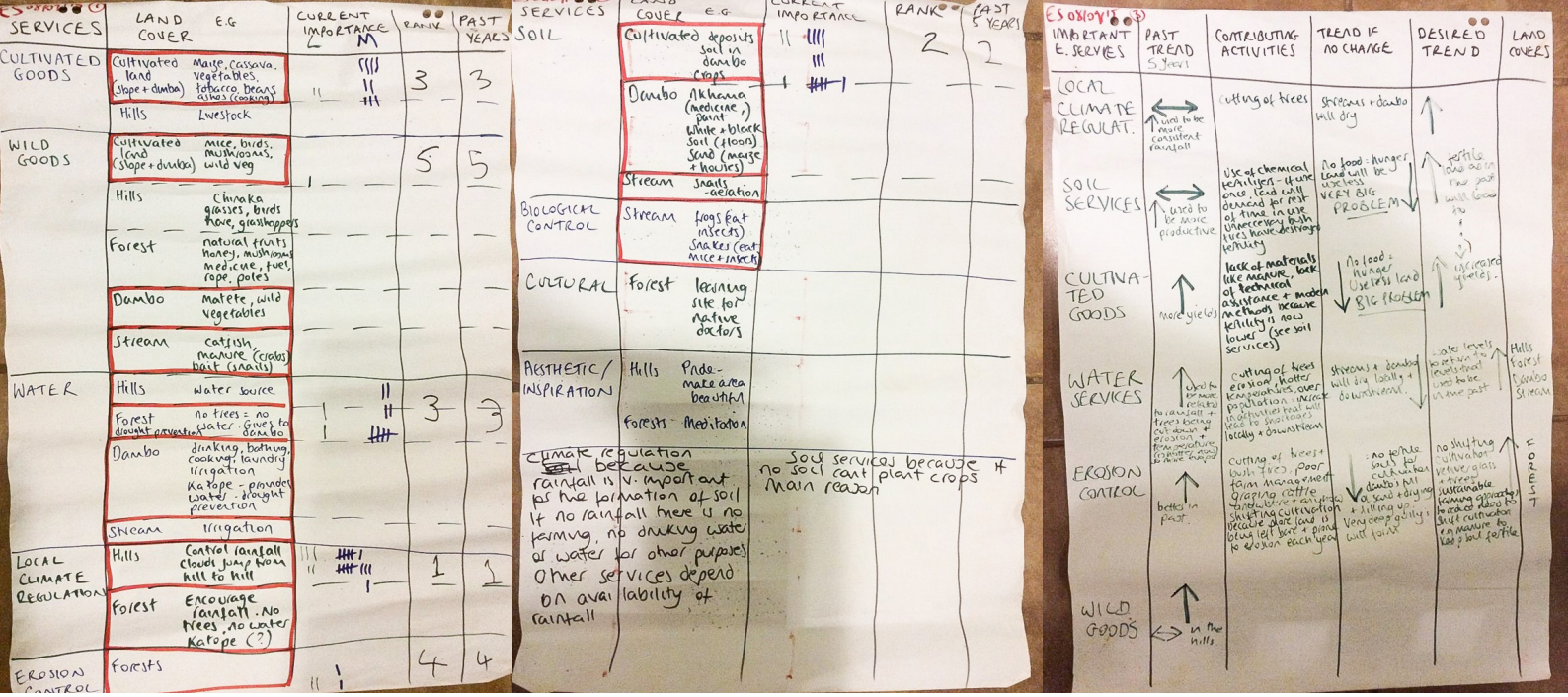
1. to indicate social-ecological change in the Kankhulukulu catchment over the duration of the project (and hence establish the impacts of the FLA);
2. to train community members in low-tech and sustainable monitoring and assessment techniques, thereby building local capacity for monitoring and evaluation to inform adaptive management practices;
3. to facilitate knowledge exchange among participants, again as a means of enhancing adaptive capacity.

Low-tech manual rain gauge.

Rainfall monitoring was undertaken using manual rain gauges operated by the farmers themselves, and one automatic rain gauge located at the head of the catchment.

Streamflow level monitoring using level-loggers were installed at the top, middle and bottom of the catchment.

Soil monitoring was undertaken by farmers across 18 locations, and was informed FAO's LADA Project manual (FAO 2013). Soil was assessed for pH, electric conductivity, structure (hard pans and aggregate particle distribution), infiltration, dispersion and



Ecosystem services associated with different landcover.

slaking, soil depth, soil colour, roots, animal life and soil texture. The data collected was first presented to farmers in a group meeting in October 2016, generating significant interest and the desire for more research on specific upland and dambo plots.

Ecosystem services monitoring and assessment was undertaken using a range of methods at different times throughout the project. During the first year activities were informed by the TESSA toolkit (Peh et al 2013) and involved participatory assessments of landcover and the ecosystem services obtained from different areas, before considering the quantity and quality of these over the previous and the potential impacts associated with a decline of these in the future. In another monitoring initiative, farmers were loaned digital cameras and tasked to record the animals and plants they consider important or influential in their livelihoods over a period of a year. This served as a basis for further group discussions on environmental change.

Livelihoods monitoring was based on the Sustainable Livelihoods Framework (Scoones, 1998) around which discussions of changes in assets, income and expenditure, and the status of farming activities took place in individual and group meetings from October 2015. Each participating farmer was supplied with a notebook to record their income, expenditure and any livelihood event considered important to them. As well as helping the research team understand livelihood dynamics, there was a feeling among farmers that these discussions were extremely helpful in helping them see the 'bigger picture' and plan their finances and activities more effectively. Interestingly, some farmers expressed concerns over some of the information being shared within the household in terms of wanting to keep their individual spending activities from their spouses. In addition to direct livelihoods monitoring, annual participatory resilience ranking exercises also explored farmers' perceptions of the changes in their livelihoods.

Village savings and loans training and committee

Having identified the lack of savings as a barrier to on-farm investment and livelihood diversification, the group requested training in village savings and loans arrangements, despite some members having already been trained previously by the NGO Temwa. Consequently, a village savings and loan initiative was established in November 2015 commencing with the election of a committee and discussion of rules and policies. Those participating were asked to contribute funds to the village bank which could then be loaned out and paid back with interest. However, confusion over the functioning of the village bank during the first year of the project meant that only farmers who contributed funds to the bank could take out loans. Moreover, since the rules dictated that these loans accrued interest (20% rate for members), there was ultimately little incentive for anyone to deposit money in the bank. In some instances, farmers taking out loans did not repay and this led to considerable tension within the group. Nonetheless, by December 2016 Kankhulukulu village bank had K209,550 in savings and this doubled following the donation made by visiting University of Worcester students (although at the time members regarded this donation as funds to be distributed among the group rather than a contribution to the bank).

The village savings and loans committee cashbox.

Subsequently, the research team arranged a two-day training for 22 farmers in February 2017. This was faciltated by Mr Chawangwa Ng'ambi, a consultant from Livingstone Synod AIDS programme, who had run similar sessions for NGOs including World Vision and Plan Malawi. The training involved election of a new committee, the creation of a social fund for the community, a new constitution, and the creation of an improved banking system characterised by more pragmatic interest rates (10%) and the issuing of village bank 'shares' proportional to savings. This training was considered a great success by farmers in terms of clarifying the functioning and benefits of savings and loans; during a group meeting one month later, committee members had developed plans to establish themselves as money lenders for the nearby village of Bula.

Village bank training session.

Knowledge sharing committee

A knowledge-sharing committee was formed early in the project and involved all the members of the Kankhulukulu FLA group. The committee organised a range of activities including weekly visits to each other's farms to showcase their own experiences and innovations. These visits often included tutorials and demonstrations of practices such as compost-making, contour terracing, crop diversification and erosion control. In discussing further potential knowledge gaps, the committee organised training visits to external communities at Kajowola, Kavukula and Ngoli (see below).

Visit to the Kajowola marketing group

In response to the FLA group's desire to learn from other farmers in the area, the research team facilitated a visit to Kajowola community in Chikangawa EPA, 30km south of Mzuzu, whose farmers had worked previously with JOCA (Japan Overseas Co-operative Association) in developing a 'Self-Reliance and Community Empowerment' programme between 2005 and 2012. Key outcomes of this programme included the creation of strong committees for co-operative agricultural production that complemented individual cultivation activities. The Kajowola community is notable for having successfully diversified into garlic, onion, ginger and potato production, which has been highly profitable for farmers. The community has also established itself as a learning hub in the area, to which other farmers travel for advice and training.

19 farmers from Kankhulukulu travelled by minibus to Kajowola and received training from Kajowola club members in:

- production of garlic, onions and sugarcane as a means of income diversification;
- self-organisation and co-operation in marketing activities;
- searching for reliable buyers of agricultural produce from dambos and upslope fields;
- negotiating with buyers and price setting.

Kajowola training visit.

The visit had a transformational impact on Kankhulukulu's farmers in terms of identifying what could potentially be achieved in their own community and as part of the FLA. It boosted participation at FLA group meetings – from 12 to 22 – and led to the establishment of a dambo demonstration site in which the lessons learned from Kajowola were applied. It also instigated the formation of a marketing committee. In subsequent meetings, the FLA group acknowledged that the visit had demonstrated very clearly the importance of knowledge exchange and hence had laid to rest their preconceived ideas about NGOs only being effective when they distribute financial or physical assets.

Marketing committee

Following the Kajowola visit, the marketing committee explored links with potential buyers including Mzuzu Technical College, Marymount Secondary School, Shoprite supermarket, and other vendors in Mzuzu market. However, buyers requested samples of produce before any contracts were arranged.

Social welfare committee

Formation of the Social Welfare Committee similarly developed from farmers' experiences on the Kajowola visit, and was established as a means of providing food for visitors and for participants in FLA group activities. However, the committee was disbanded within a year due to internal disagreements over responsibilities and mistrust relating to the ownership of committee assets.

Expert Banda (seated left).

Expert Banda explains the importance of good soil management.

Training visits by Expert Banda

The Kajowola visit had far-reaching impacts on how the FLA group viewed their own livelihood situation and the FLA project, and as a follow-up, the Kajowola leader, Expert Banda, was invited to visit Kankhulukulu on three occasions to train FLA group members in a range of themes including:

- Group dynamics (to strengthen the group and achieve their goals);
- Principles of self-reliance;
- The farming and marketing calendar;
- Dambo preparation and winter crop management;
- Incorporating environmental management in dambo farming;
- Manure making (several types of manure from different raw materials);
- Marketing techniques for crops;
- Importance of record keeping for farmers;
- Budgeting and saving techniques;
- Individual evaluation and goal setting.

The FLA group were particularly interested in Expert Banda's advice on onion, garlic and ginger farming, and planned to grow these during the next winter season. The FLA group hailed Expert Banda's visits as the most successful of all the training sessions they had ever attended on account of the relevant advice and due to it being delivered by a fellow farmer with an in-depth understanding of their own situation. Notably, the third visit made in September 2017 to check the progress of the FLA group, was fully coordinated by farmers themselves following the formal end of the FLA Project in August 2017.

Dambo demonstration garden and committee

The Kajowola and Expert Banda training inspired farmers to establish a dambo demonstration site and committee to oversee its management. The demonstration site in the valley bottom adjacent to the Kankhulukulu stream was to serve as a learning and experimentation site for farmers to grow crops unsuitable for the uplands, e.g. tomatoes, onions, garlic, carrots and sweet potato. Here, farmers intended to use the profits from the sale of their dambo crops to fund the FLA marketing committee and specifically the transport of crops to market. Land management in and around the dambo included the planting of Katope trees, and the reservation of natural vegetation buffer zones around the dambo plots to prevent erosion and maintain soil fertility and water levels. Tephrosia was also intercropped and the leaves used as insecticide.
A key challenge for the dambo committee was the frequent changes in committee membership caused by disagreements over land preparation arrangements. Despite this, the committee was able to develop a series of rules, penalties and conflict resolution procedures, and the yields from the dambos were able to boost food security and supplement the income of participating farmers.

Kankhulukulu dambo demonstration site.

Deep-bed farming

Initially, fewer than 10 farmers expressed an interest in adopting deep-bed farming as part of the FLA, although by July 2016 all of the FLA group were keen to participate, having become aware of the benefits from one successful farmer. The first training session of the Kankhulukulu Tiyeni Demonstration Garden occurred in October 2016, and shortly thereafter farmers received the standard Tiyeni package of hoes, panga knives, fertiliser (NPK and Urea) and seeds (maize, beans, groundnuts, soya and ground beans locally known as Nzama). By January 2017 all FLA farmers had adopted some (although rarely all) elements of DBF. In January 2017, a team of Tiyeni lead farmers and the FLA group Chair inspected the plots of those receiving the Tiyeni package and found inconsistencies in DBF implementation - from missing box ridges, to wide and shallow beds, and incorrect crop spacing. Notably, one of the farmers, Square Msumba, was particularly active in recording the differences between DBF and conventional ridge cultivation and had designed his own trials. He concluded that DBF led to higher yields and less soil erosion, and hence he extended the proportion of his land under DBF in the second year.

Upe in her DBF plots (showing poorly constructed raised beds).

Visiting degraded wetlands: Ngoli and Kavukula

Having benefitted greatly from the Expert Banda training on the livelihood benefits of agricultural diversification, marketing and dambo use, farmers expressed a desire to understand the potential environmental impacts of dambo overexploitation. This discussion lead to a visit in November 2016 to dambos in Ngoli and Kavukula communities near Mzimba to learn from the experiences of others. This was facilitated by Albert Msuku, community development facilitator for Kavukula, who had overseen the development of an FLA group in that community under the guidance of NGO Wetland Action. 19 farmers from Kankhulukulu visited the dambos.

While both Ngoli and Kavukula communities had plentiful wetland in the past, the two areas experienced high rates of degradation between 2005 and 2016 as new dambo areas were cleared, drainage ditches excavated, and farmers allowed uncontrolled livestock grazing and the cutting down of Katope trees. During a tour of the catchment Kankhulukulu farmers were shown degraded and sandy dambos, dried up wells, and gullies. Here, they discussed how the wetlands became degraded and how this could potentially be reversed, drawing on their experiences and knowledge gained from their prior visit to Kajowola. In Kavukula, farmers were introduced to a community attempting to address the environmental degradation through organising new committees and responsibilities. Subsequent discussions revealed how Kankhulukulu farmers had been shocked by the decline in natural resources as illustrated by resource maps from 1947 and 2016 constructed by Kavukula farmers.

Gullying observed in Kavukula dambo.

Key project outcomes and impacts

At its peak membership the FLA project included approximately 30 farmers and their families, although for most of the project a core of around 20 farmers participated and hence were the key beneficiaries in terms of the enhancement of livelihood assets, adaptive capacity and social-ecological resilience. However, discussions with members revealed a wider influence of the Kankhulukulu FLA project, as group members disseminated their knowledge and experience throughout adjacent communities and further afield throughout the region (via the knowledge exchange training visits and the links with the NGOs Tiyeni and Wetland Action).

Community institutions, social capital and knowledge-sharing

Arguably the project's most significant success was the enhancement of social capital within the community. This was evidenced in the creation and self-mobilisation of participants into five different committees, each responsible for managing a different element of the Kankhulukulu social-ecological system, and each having their own constitution developed through a participatory process involving all stakeholders. These institutions, and the FLA itself, provided focal points for innovation, action, and knowledge exchange, and there was evidence throughout the project that this led to the enhancement of other livelihood assets (e.g. knowledge and skills, financial capital, the acquisition of physical assets). Critically, these committees and their activities were seen to evolve throughout the course of the project in response to changes in membership, needs or unforeseen issues, and hence evidencing adaptive capacity. Moreover, farmers created and remained members of these committees (and indeed

the overarching FLA group itself) because there were clear benefits to them in doing so; a critical, if obvious, prerequisite to functional and sustainable community institutions. The training visit organised by the knowledge sharing committee are a prime example of the 'transformational' impacts that resulted from the common desire to learn from others (while also evidencing Kankhulukulu farmers' commitment to sharing their own experiences with those further afield). An analysis of the changes in social networks undertaken at the end of the project revealed significant enhancements in terms of farmers' access to support, encouragement, knowledge, as well as an enhanced capacity to self-organise.

Livelihood development and resilience

As outlined earlier, at the core of the FLA is the process of empowering and instituting self-organisation and adaptive co-management among participants. Having achieved this through institution-building and social networking, the Kankhulukulu FLA group were able to make significant gains in their livelihood security in terms of income diversification, food security, enhancements in natural capital, and an increased resilience to climate shocks and pressures (Figure 4). For example, income diversification and food security can be attributed to an increase in dambo use, adoption of the Tiyeni DBF, crop diversification and innovation following the training visits, and the availability of financial capital from the village bank that was reinvested in farming.

Annual participatory resilience ranking exercises revealed some gains in terms of farmers' assessment of their own resilience (based on their access to basic needs) (Box 2). In the final year, 13 out of 18 farmers felt their resilience had improved from the previous year, and the remaining 5 expressed confidence that their situation would improve. Those farmers considering themselves resilient typically attributed this to their use of dambos and DBF, applying the lessons from their training visits, and access to funds from the village bank. As well as being food secure, resilient farmers were able to afford school fees for their children and farming equipment. Farmers who considered themselves vulnerable, meanwhile, cited old age, illness, a reliance on family members and fluctuating market prices as affecting their livelihood. Although 'vulnerable' farmers acknowledged how they had benefitted from new knowledge acquired by their involvement in the FLA, their inability to apply this knowledge due to labour and resource shortages remained a significant hurdle for them.

Figure 4 - Assessment of the short-term change in FLA outcomes within the Kankhulukulu community (using methodology by Sayer et al. 2016 and Buck et al. 2006).

Institutional objectives

a	Committee representation
b	Active participation
c	Integration of village/district agendas
d	Use of marketing calendar
e	Organic crop production
f	Income from cooperative sales
g	Fines for rule-breaking
h	Supportive networks tbc

Livelihood objectives

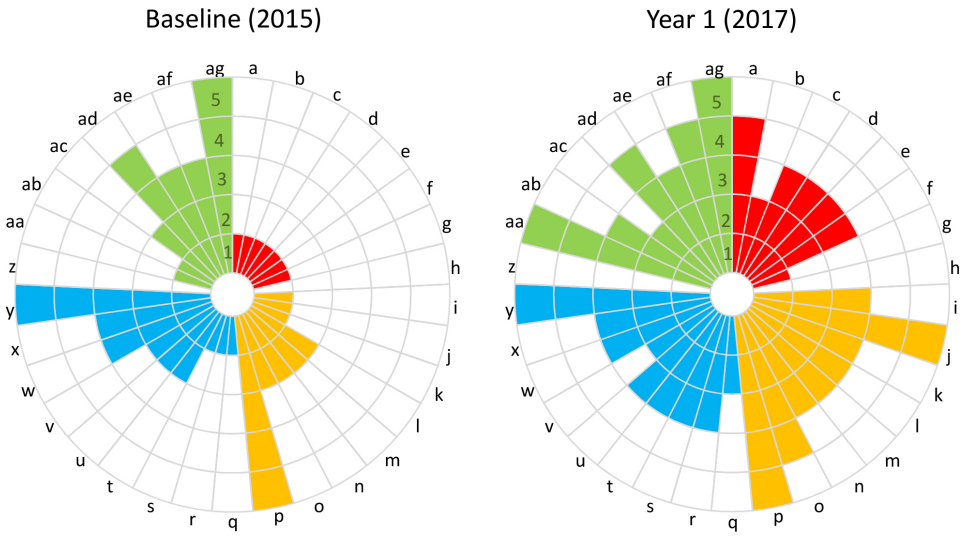
i	Upgraded housing
j	Ability to save
k	Adaptive catchment planning
l	Access to clean domestic water
m	Reduced hunger
n	Can pay school fees
o	Access to local cultivation inputs
p	Access to valued wild goods

Production objectives

q	Reduced irrigation need
r	Sustainable dimba technologies adopted
s	Income from sustainble technologies
t	Sufficient yields for income generation
u	Experimentation
v	Pests killed
w	Fertilizer use & soil health
x	Crops lost to poor soil/flood/drought
y	Dimba crop diversity

Conservation objectives

z	Deforestation
aa	Adoption of Tiyeni
ab	Retention of buffers and trees
ac	Burning
ad	Irrigation water accessible
ae	Crop loss to pests
af	Agrochemical use
ag	Rare wild goods



Scale (usually!)

1	< 25% of group (catchment)/baseline established
2	At least 25% of group
3	At least 50% of group including vulnerable
4	At least 75% of group including most vulnerable
5	At least 90% of group including most vulnerable

Box 2 - Farmer resilience stories

Patson Silumbu ('medium resilience')
Patson is originally from Chitipa but moved to the Bula area in 2013 when a friend offered him land to farm. He now farms dambo and upland areas, although these are outside of the Kankhulukulu catchment. Patson joined the FLA group in 2016 after seeing Matthews walk by on his way to meetings, and after speaking to his neighbour Kayamba. Since joining, Patson has been elected as Chairman of the Marketing committee, and has visited schools and markets in Mzuzu in an attempt to find markets for the Group's produce. Patson considers himself to have 'medium resilience', since last year he farmed alone because his wife was pregnant. He found it challenging to produce enough food for consumption and income generation. However, he is usually able to grow cabbage, tomatoes, rape, mustard and other cash crops, and recently he has started to cultivate potatoes. These supply his basic needs in the home and allow hm to recover from any problems that may strike his family at any time. Patson says that among other things, the Expert Training inspired him to build a brick house to replace his current one made of trees and mud, in which he lives with his wife and two children.

Upe Chiumia ('medium resilience')
Upe was born in Zambia where she grew up until her parents moved back to Malawi. She is involved in many activities in Bula such as the Women's club and primary school teaching. She is also well known for her active role with Temwa Malawi where she is one of the lead farmers. Currently, she is the vice chairperson of the Kankhulukulu FLA Club apart from being a member of other sub-committees such as the marketing committee, dimba committee, village bank and monitoring committee. Upe grows maize, beans, soybeans, groundbeans, cassava, bananas, potatoes, pumpkins, rape, mustard vegetables and other common crops in both slope and dimba. Upe does not struggle so much in finding basic needs including school fees for her children. She farms and has enough food and surplus to sell for income. However, she has remained in the 'medium resilience' category because she says her many activities makes it hard to concentrate on one or few things which can yield her maximum benefits.

Emeliya Chilenga ('vulnerable / poor')
Emilya and her husband moved to Kankhulukulu from Chitipa around 14 years ago, and currently have 10 children. Having lived in dire poverty for a very long time she had previously considered herself as 'very vulnerable', but after joining the Kankhulukulu FLA Group she feels she has moved up to the 'vulnerable' category. Unable to afford artificial fertilisers, Emilya has benefitted from higher crop yields after learning about manure-making and receiving a goat that provides manure. Via the FLA group she has also adopted deep-bed farming that conserves soil and water and improves yields. She also maintains that she is now knowledgeable in dambo farming, marketing and also how to be a 'good' group member. The Expert Banda training opened her eyes to the importance of saving what little she earns. She has joined a village bank at nearby Bula because the Kankhulukulu village bank was already in the middle of the year, but she plans to also join this and is keen to get a loan to start a small business. Emeliya will also be growing tomatoes and vegetables for income generation.

Lynas Msumba ('very vulnerable / very poor')
Lynas moved from Nkhotakota to Kankhulukulu in 2003. She is widowed and lives with four of her grandchildren in a brick house along the Bula road. She farms approximately 0.24 ha of upland and 0.16 ha of dambo, both of which she describes as challenging on account of her health problems. When asked why she thought she is 'very vulnerable', Lynas replied that she has a house with mud floor and struggles with basic needs such as soap, salt, milling bills, clothing and other things. She is particularly vulnerable to food insecurity between January and March, and during this period often depends on relatives and neighbours. She has coffee, avocado and banana trees and sometimes sells a plate of beans, or the fruits to people passing by. When asked about the impact of the Expert Banda training, she said that she is very old, making her unable to put the knowledge learnt into practice. During the resilience ranking exercise, other farmers accused Lynas of exaggerating her poverty since they noted she has money and an iron-roofed house, which puts her in a better position than younger farmers. Responding to this, Lynas joked that putting her card anywhere else would make the white people think she lives a better life, and therefore she would not receive help with anything.

Benson Kumwenda ('medium resilience')
Benson lives in the Kankhulukulu area with his wife and six children, and farms upland (0.3ha) and dambo (0.1ha) of which he sells approximately 60% of the crops he grows. He first started to grow tomatoes, onions and maize in his dambo in 2003, and although the yield has decreased over time it remains sufficient to feed his family and add to the income he earns from carpentry and other activities. His experience of dambos led to him being elected Chair of the Dambo Demonstration Garden committee, a role he describes as 'exciting and demanding'. Benson says he has learned so much from the Expert Banda Training, which made him reflect on his problems and how to solve them. He does not struggle anymore to finance his home budget. One of his sons is studying at the University of Malawi and he is now able to pay the fees for this. Currently, he is working towards the completion of his brick house.

Natural vegetation buffer strips between dambo and upland.

Sustainable environmental management

The participatory ecosystem services assessments revealed concerns about declining forest cover, water security, climate change and soil conservation, but also a desire from farmers to take action to improve natural capital in the catchment. This became the justification for DBF adoption, contour terracing, multi- and inter-cropping, agroforestry, conservation of Katope trees, the use of buffer zones, and restrictions on deforestation, all of which were supported by the newly formed community institutions and complemented by community-led environmental monitoring.

Embedding the FLA and social-ecological thinking

Despite considerable confusion surrounding the goals of the FLA during the early stages of the project, farmers quickly understood the rationale of enhancing and balancing positive livelihood and environmental outcomes, perhaps unsurprisingly given that their livelihoods are fundamentally experienced through a social-ecological lens in which development is inextricably connected to the environment. Moreover, their self-organisation into various committees illustrates well their understanding of the benefits of collective action in managing 'the commons', whilst also embodying adaptive co-management characterised by reflexive practice. This arguably bodes well for the future sustainability of the kankhulukulu social-ecological system.

The process of implementation and community relations

A key problem throughout the project was managing the expectations of participants, in terms of the deliverables so frequently associated with NGO interventions in this area. Even when on occasion the research team felt they had 'turned a corner' in presenting the FLA as a 'facilitating' and capacity building initiative rather than one that simply supplies physical assets, some farmers continued to make requests for resources and seemed unhappy when none were forthcoming. Moreover, there continued to be an element of competition (and to some extent, conflict) between members of the group for the status and influence that was perceived to be associated with certain committee roles. This was particularly evident in the social welfare committee and the village bank, which required strategic decisions over finance to be made.

Conclusions

Implementation of the FLA in Kankhulukulu over a three-year period represented a significant opportunity to further test and reflect on the strengths and weaknesses of this community-based social-ecological approach to delivering livelihood and environmental benefits. Critically, unlike previous FLA implementation scenarios across sub-Saharan Africa, our non-NGO, long-term, action research mode of implementation gave the community the space and ownership of the FLA process from the very start; the FLA was presented as an approach incorporating a menu of flexible options that could be either used, discarded, or modified in accordance with the unique Kankhulukulu social-ecological context. While this apparent flexibility was initially perplexing for members of the community used to more traditional top-down NGO projects providing extension support, the process became empowering and transformational for those involved.

Katope tree in a dambo buffer zone.

The Kankhulukulu community were able to assess the status of their own livelihoods, their relationship with natural resources in the catchment, and their future needs and aspirations in terms of resources and training needs. In doing so they developed a long-term action plan for enhancing their livelihood assets, and over the three years worked collectively towards implementing this. Key achievements included the self-organisation of the community into committees responsible for the governance of different social-ecological components, the development of low-tech environmental monitoring programmes, enhanced knowledge exchange between members and external communities, and the adoption of innovative farming and environmental management techniques in the catchment and valley bottom wetlands. This implementation of practical measures underpinned by their own local institutions, has led to significant gains in terms of enhanced food security, income generation, and critically, adaptive capacity and social-ecological resilience.

While the research confirms the benefits of adopting and implementing the FLA, we also recognise the resource constraints that many NGOs work under and that would preclude such an intensive programme of facilitation with one community over

an extended time period. This echoes experiences elsewhere on the challenges of implementing landscape approaches in the real world (Sayer et al. 2013; Freeman et al. 2015). In our experience, however, challenging and moving beyond preconceived ideas within the community about the role of 'outsiders' in delivering development, was the critical first step towards facilitating self-mobilisation, reflection and action.

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